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Andreea Cosnita, Jean-Philippe Tropeano

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Andreea COSNITA

Jean-Philippe TROPEANO

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# On the Effective Design of the Efficiency Defence

**Andreea Cosnita**[*]and **Jean-Philippe Tropeano**[†]
Centre d'Economie de la Sorbonne[‡]- University of Paris I

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[*]cosnita@univ-paris1.fr, corresponding author
[†]tropeano@univ-paris1.fr
[‡]Maison des Sciences Economiques, 106-112 Bd de l'Hôpital, 75647 Paris cedex 13, FRANCE
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**Abstract**

The efficiency defence was long delayed in the European merger control due to costly implementation issues. In this paper we argue that the upstream consequences of the efficiency defence should equally be considered, namely the improvement of the distribution of notified mergers through the incentives it provides towards more efficient mergers. First of all, we show that even if the Competition Authority may not tell apart the mergers that rightfully invoke the efficiency defence from those that do not, allowing such a procedure can lead to a lower post-merger price. Secondly, we study the impact of merger remedies on the incentives conveyed by the efficiency defence, and conclude on the optimal design of the efficiency defence procedure.

Keywords: merger control, efficiency defence, merger remedies
JEL classification: L41, K21, D82

**Résumé**

La procedure d'"efficiency defence" a été jusqu'à recemment absente de la législation européenne sur le contrôle des fusions en raison des problèmes pratiques d'implementation qu'elle soulevait. Notre propos dans ce papier est de rappeller qu'au délà de ces problèmes, des effets incitatifs positifs sont à attendre lors de l'application de cette procedure, notamment dans le sens d'encourager les firmes à entreprendre des fusions plus efficaces. Dans un premier temps, on démontre que l'espérance de prix peut baisser avec cette procedure, en dépit de l'asymétrie d'information qui caracterise la relation de contrôle des fusions entre l'autorité de la concurrence et les firmes fusionnantes. Ensuite, on prolonge notre analyse des effets incitatifs en amont de l'"efficiency defence" en y ajoutant un outil largement utilisé actuellement, les remèdes. Ainsi, dans un deuxième temps on caractérise le contrôle optimal des fusions en termes des deux procedures : "efficiency defence" et remèdes des fusions.

Mots-clé: contrôle des fusions, procedure d'"efficiency defence", remèdes des fusions

## 1. Introduction

Merger control was designed as a firewall against anticompetitive mergers, but different competition authorities typically held different views of merger control. While some countries allowed efficiency gains to be explicitly taken into account for the merger assessment[1], others rather overlooked them. It is not until recently that an explicit Efficiency Defence[2] (ED henceforth) began to apply for European mergers[3], so for the time being little can be inferred in terms of firms' reaction to this new regulation.

Taking into account the upstream consequences of the ED, not only its downstream consequences in terms of costs due to its application, amounts to adopting a different standpoint on the role of the merger control: not only rejecting anticompetitive mergers, but also providing incentives for mergers to be more pro-competitive in the first place. The assessment of merger control ought to account for this double purpose addressed by the merger control instruments or procedures, namely both preventing the anticompetitive effects and promoting the upstream incentive towards more competitive mergers.

This article claims that allowing an ED ought to improve the outcome of the merger control to the extent that it gives firms incentives to undertake more efficient mergers than they would otherwise attempt, and this is preferable for the Competition Authority (CA from now on), given its objective of Consumers' Surplus maximization. This result may seem intuitive. The analysis performed in our paper is nevertheless more involved, since we equally discuss the opportunity for the CA to apply remedies together with the ED. To our knowledge, no work has been attempted so far with respect to the optimal merger policy mix between divestitures and the ED procedure, which is the second objective our paper addresses.

The model we propose focuses on firms' decision in terms of choice of merger to undertake, and basically claims that the ED clause will alter the distribution of

[1] Such as France, Canada, Australia or New Zealand.

[2] Broadly speaking, the ED involves the global assessment of both positive and negative merger effects, for the declared purpose of improving the merger control outcome.

[3] See the Council Regulation (EC) No 139/2004 of 20 January 2004 on the control of concentrations between undertakings (the EC Merger Regulation) - Official Journal L 24, 29.01.2004, paragraph (29), p.4: "In order to determine the impact of a concentration on competition in the common market, it is appropriate to take account of any substantiated and likely efficiencies put forward by the undertakings concerned.[...] The Commission should publish guidance on the conditions under which it may take efficiencies into account in the assessment of concentration."

notified mergers for the better. Firms may choose ex ante between different merger opportunities, more or less efficient. However, the design of an efficient merger requires a costly effort, which moreover is private information for the merger partners. The CA has the choice between applying or not the ED, meaning that it may or not take into account the possibility of efficiency gains as an argument for clearing the merger. We find that allowing the ED can be optimal, despite the fact that the CA has imperfect information on the efficiency outcome of mergers, thanks to the effort provision incentive effect. In the end, the expected price can be lower with the ED merger control, should all firms eventually submit the same type of merger.

Concerning the application of remedies, we remind that on the one hand, the use of divestiture injunctions is meant to prevent any price raise following the merger, which is clearly an advantage given the asymmetric information setting. On the other hand, remedies soften the threat of blocking a merger, in as much as firms avoid with certainty the status-quo situation, and this encourages them to run the risk of unrightfully applying for the ED procedure[4]. Our model accounts for the impact of merger remedies on the ED procedure, and thereby studies the optimal design of the ED, depending on the quality of information available to the CA. Based on the likelihood of the effort provision, which we take to be the necessary condition to obtain the lowest price, the CA is likely to prefer the stricter ED without remedy when good information is available, whereas associating remedy to the ED is desirable when the risk of error is high. This is worth pointing out, since it implies that despite a substantial risk of error, the CA might nevertheless prefer to tolerate the pooling outcome induced by the ED with remedy, in order to provide higher effort incentives[5]. To put it differently, for low quality signals, the flexible ED (with divestiture) yields the highest effort incentives, whereas with high quality signals, the strict ED does so instead.

Consequently, in terms of optimal merger control, we find that for low levels of the effort cost, the CA always requires remedy, coupled with or without an

[4]Actually, the use of remedies is often acknowledged as a signal of a "soft" merger policy - see Seldeslachts et al. (2006) for a recent test and confirmation of this hypothesis.

[5]In the field of patent law and innovation policy, a similar effort incentive effect was highlighted by Caillaud and Duchene (2004), who discuss the overload problem faced by the US patent office. They find that the optimal patent examination process should accept a number of "bad" patents within a pooling equilibrium, since it encourages the up-stream R&D, so that more "good" patents would eventually be granted. In our framework, even though all firms might eventually submit the same type of merger, the ED procedure can be optimal provided it gives upstream incentives to exert the effort needed to lower the market price.

ED, depending on the available information quality. In turn, the strict ED can be optimal for higher levels of the effort cost, in which case there is conflict between the ED and the divestiture. For a given effort decision on behalf of insiders, the divestiture is actually preferred by both the CA and the merging firms. Yet, for a range of high effort cost, it actually does not convey the highest effort incentive, hence the above-mentioned conflict.

As before mentioned, this article basically underlines that a given merger regulation is likely to change the distribution of mergers to which it eventually applies. The same intuition is exploited by Barros (2003), who analyzes the change in the design of cooperative agreements induced by the shift from an ex-ante to an ex-post control regime under the European Commission reform of the Communitary competition policy[6]. More recently, Ecer (2005) argues that it does make sense to assume that merging firms react to the existing merger control provisions, and that they design merger projects accordingly[7]. He shows that the tendency to apply a stricter merger policy may prove ineffective, since firms endowed with rational expectations are able to bypass it by devising strategies to sustain higher market prices in equilibrium.

Concerning merger policy[8], Besanko and Spulber remarked as early as 1993 that "the size and type of firms that contemplate mergers are determined not only by the anticipated returns from the merger but also by antitrust merger enforcement". However, the main purpose of their article was to study the consequences of the information asymmetry about the merger's efficiency gains for the formulation and enforcement of merger control. The opportunity of an ED was actually long debated[9] because of its associated implementation costs. Indeed, the main argument against the ED procedure was the prohibitive cost of information acquisition due to the context of asymmetric information for the CA. Without perfect information, the ED procedure raises the question of the costly verification of those alleged efficiency gains. Lagerlöf and Heidhues (2005) explicitly deal with this issue, and identify the conditions under which the cost trade-off does warrant

[6]See also Bergès-Sennou et al. on the same topic, but from an opposite standpoint.

[7]Neven et al.(1993) equally note that merger control may result in "[...] mergers that would otherwise be attractive to firms, but that they do not even try to undertake because of fear that they will not be approved [...] or in transactions that may take place in a form different from that that they would have taken in the absence of regulation" - Mergers in Daylight, p. 137.

[8]See also Seldeslachts et al (2006), who briefly review the literature suggesting that the merger policy instruments do have upstream effects on firms' merging projects, before testing for the deterrence effects of these instruments.

[9]See Ilzkovitz and Meiklejohn (2001) for a survey of this topic.

the desirability of an ED. Their results claim that an ED is not worth while if it is too costly for society as a whole, through the evidence production costs it entails on behalf of merging firms. We choose to neglect here the cost side of the debate, only to better focus on the analysis of the effort-provision incentive effect of the ED procedure.

The remainder of the paper is organized as follows. We present next the model, then discuss efficiency defence as an incentive device. The last section concludes.

## 2. The Model

### 2.1. Technology and market structure

We consider a simple though general framework consisting of competition between four firms. They are identical indivisible entities, using the same cost technology. Given that mergers to monopoly are prohibited by law, two types of alternative mergers can possibly occur, of either two or three partners. We specify our ED setting so that these two types allow for both more or less profitable mergers, on the one hand, and also for more or less anticompetitive mergers on the other. For that, we shall consider a group of three firms who jointly decide whether to attempt a 3-firm merger or only a 2-firm one, and we allow side-transfers among firms, so as to deal only with the total profit generated by the group of firms[10].

To begin with, mergers typically involve both a market power increase and some cost savings. This will also be the case here, but we shall only deal with the net outcome of these two opposing effects, through the merger's price consequences. This is consistent with the actual ED procedure, which is precisely supposed to undertake a global merger assessment so as to determine the net effect. On the one hand, in our framework the choice of merger partners (1 or 2) will lead to a particular design of the merger project, less or more anticompetitive. At the same time, we equally assume that the same mergers that have the potential to raise price can generate merger-specific efficiency gains (EG henceforth), through some costly effort $e$. More precisely, we assume merger partners to be able to exert a certain conception effort for the design of their association, which can hereby increase its pro-competitive potential[11]. To underline the necessity

[10] This allows us to discuss the issue of merger choice/design on behalf of the merging firms. Basically, the merger choice results either form the choice of the identity of merging partners, or the choice of their number. For simplicity, we chose the second option.

[11] A possible example of such a context is given by the joint ventures cases that were formerly

of this beforehand pro-competitive design of the merger, we assume that firms exerting this effort incur a total fixed sunk cost of $F$. To put it short, without this prior effort, the merger can only raise price ex-post. Note that we do not take these EG to be merger synergies, in as much as the effort required for their materialization is achievable before the actual integration of merging partners[12].

We start next the list of assumptions consistent with the above framework. Denote $\Pi_i$ the initial stand-alone profit before merger. To establish notations, let all other profits be expressed with the help of the corresponding market structures. Let $\Pi(2,1,1)+\Pi(1,2,1)$ be the global profit of three firms going in for a 2-firm merger, $\Pi(3,1)$ the profit of a 3-firm merger without effort, and $\Pi(3^e,1)$ the profit of three firms with effort or EG, since we assume the outcome of effort to be certain.

*Assumption 1 - Profits*: all mergers are profitable, any 3-firm merger is more profitable then a 2-firm one, effort increases merger profitability, and there is no market exit following any of the mergers. In other words, the following hold: $\Pi(3^e,1) > \Pi(3,1) > \Pi(2,1,1)+\Pi(1,2,1) \geq 3\Pi_i, \Pi(1,2,1) > 0, \Pi(1,3^e) > 0$. Basically, the higher profitability of 3-firm mergers is justified by their higher marker power increase. Also, in order to have a consistent trade-off concerning the effort choice, let $F \geq \Pi(3^e,1) - \Pi(3,1)$, otherwise making effort is strictly dominant for firms.

### 2.2. Merger control and market structure

To materialize their merger, firms need the approval of the Competition Authority. As far as the latter is concerned, we consider its objective to be Consumers' Surplus (CS) maximization[13]. The following assumption describes the anti-competitive effect of mergers, and hence the CA's order of preferences:

*Assumption 2 - Price order*: $P(3,1) > P_i \geqslant P(2,1,1) > P(3^e,1)$

First of all, we assume any 2-firm merger increases consumers' surplus, meaning

cleared in Europe under the article 85(3). Typically, the argument of the parties in favour of their cooperation was the prior costly investment undertaken to smooth technological transfer and to enhance the complementarities between partners. See for instance Jorde and Teece (1990) and Shapiro and Willig (1990) for a review of such cases and their anti-trust treatment at the time.

[12] Typically synergies can only materialize ex-post, after the merger itself. We do not however deal with the post-merger effort or incentives to achieve these synergies.

[13] This is actually more restrictive than the CAs' current practice, according to which any merger that does not raise price should be accepted.

it is a "safe" merger from the CA's standpoint. This actually occurs in practice whenever CAs automatically clear mergers that do not increase by much market concentration and thus do not exceed the limit thresholds computed by the CA. Implicitly therefore, the cost savings of 2-firm mergers are considered here to exceed the corresponding market power increase, which makes this merger always acceptable. In turn, a 3-firm merger without EG is anti-competitive, i.e. price increases afterwards due to excessive market concentration w.r.t. cost savings, whereas one with EG lowers the price. Thus, the CA strictly prefers 3-firm mergers with EG, but should block 3-firm mergers without EG.

We consider an asymmetric information framework for the CA, and assume that the firms' effort and its outcome are private information of insiders. Nevertheless, the CA observes an exogenous signal $s$, imperfectly correlated with the merger efficiency gains. $s$ stands for all relevant hard information that the CA can use to make its decision, which is typically obtained during the merger review process. In practice, the CA gathers pieces of information from various sources, its own expertise, the insiders themselves, the outsiders, even consumers. However, for the purpose and outcome of our analysis, only the quality of this information is relevant. Therefore we summarize all this data in an exogenous costless signal, although in practice the CA spends money and time to evaluate the merger, only to highlight even more the choice to focus on the incentive properties of the efficiency defence, and not on its cost side analysis. Finally, for simplicity, let the signal $s \in \{\underline{s}, \overline{s}\}$, with $\Pr(\overline{s}/\text{effort}) = \Pr(\underline{s}/\text{no effort}) = \sigma \in [1/2, 1]$. Based on this imperfect signal, the CA may very well reject efficient 3-firm mergers, or, on the contrary, accept anticompetitive ones, hence the possibility for both type I and II errors.

To maximize CS, the CA decides to allow or not the ED, meaning it can apply a decision rule for the 3-firm merger approval which may or may not depend on the signal received. The decision rule is either "any 2-firm merger is accepted, but a 3-firm merger is accepted only if $\overline{s}$", or "any 2-firm merger is accepted and any 3-firm merger is rejected". The former decision rule allows the ED, the latter does not.

When challenging a merger, two alternatives are available: the CA can either reject it downright and thus maintain the status-quo, or it can challenge the particular form under which the merger is notified, and thus clear the merger only if the merging firms agree to divest assets. Given the number of firms in our model and the indivisibility assumption, the divestiture implies the transfer of one individual plant either to the outsider or to a new entrant. We assume

here that the CA chooses the asset buyer[14], and furthermore that this is the outsider[15]. To the extent that remedies represent a supplementary merger control instrument which, to a certain extent, allows the CA to implement a particular market structure, we add the following:

*Assumption 3: Divestiture price effect*: $P_i \geq P(2,1,1) > P(2,2) > P(3^e,1)$

In other words, we consider the case of a successful remedy, i.e. one which prevents the price raise ($P_i > P(2,2)$), but which is not more successful than an efficient 3-firm merger from the CA's point of view ($P(2,2) > P(3^e,1)$), although it does yield a lower price than a 2-firm one ($P(2,1,1) > P(2,2)$).

We detail next the consequences of the divestiture decision, since the market structure and its corresponding payoffs are determined both by the firms' choice of merger, and by the CA's decision to require remedy.

On the one hand, Consumers' Surplus maximization gives the CA incentives to implement through remedies a lower market price. On the other hand, divestitures always imply some private cost for insiders, although they equally represent for them an opportunity to recover part of the positive externality they exert on the outsider through the merger[16]. Considering all this, we write the insiders' payoff in case of divestiture as the revenue from the asset transfer, for which the insiders make a take-it-or-leave-it offer to the outsider. Hence their payoff equals $2\Pi(2,2) - \Pi_i$.

To sum up, denote $\Pi_r$ the insiders' payoff in case of a merger refusal, and call it their reservation profit. Whenever the CA rejects the merger and maintains the status-quo, $\Pi_r = \underline{\Pi}_r = 3\Pi_i$, whereas if the merger is blocked and divestiture is required, $\Pi_r = \overline{\Pi}_r = 2\Pi(2,2) - \Pi_i$. It is straightforward to check that $\overline{\Pi}_r > \underline{\Pi}_r$. Therefore the CA's choice to apply or not remedy in case of merger refusal boils down to allowing or not firms to obtain more than the status-quo profit. The next assumption completes the framework:

*Assumption 4: Divestiture profit effect*: $\overline{\Pi}_r < \Pi(3,1)$. In other words, the remedy does involve a cost for insiders, and guarantees that the CA and the insiders have conflicting objectives[17].

[14] This comes close to the actual practice of CAs, who preserve a veto right concerning the choice of the buyer, so to a certain extent they do get to choose its identity.

[15] This may appear restrictive, but the point of our model is not the relevance of the choice of the asset buyer, but the impact of divestiture on the upstream effect of the ED.

[16] Outsiders always benefit from a price-increasing horizontal merger, and this is all the more true for Cournot competitors, who in addition gain market shares. By selling assets, insiders get partly "paid" for the change in market structure that the merger brings about.

[17] Intuitively, if the divestiture yields a higher payoff than an anticompetitive 3-firm merger,

**Remark 1.** *Our assumptions define a non void set of parameter values - see the Appendix for an explicit example consistent with this framework and also with all additional assumptions.*

### 2.3. The game

We give next the timing of the game between the CA and the merging firms, which are randomly selected by nature.

At the first stage, the CA chooses to allow or not the ED, following the decision rules above specified. At the same time, it decides on the type of blocking decision, i.e. applying or not a remedy. The CA credibly commits to a given decision rule by making it public under the form of merger guidelines, which become binding from that moment on.

At the second stage, firms decide whether to undertake or not the effort to achieve EG. The CA does not observe the effort decision.

At the third stage, firms notify to the CA a merger of either two or three partners.

At the fourth stage, the exogenous signal is generated and publicly observed. The merger is then cleared or blocked, according to the selected decision rule.

The rest of the paper compares the decision rules in order to conclude on the opportunity and the optimal design of the ED procedure. The comparison will be performed depending on whether the CA requires or not remedy when challenging a merger. A backwards induction through the game is necessary, and we begin by discussing the outcome of the ED procedure.

## 3. Optimal design of the Efficiency Defence: to remedy or not to remedy?

There is no strategic move at the last stage of the game, therefore the discussion begins with the firms' choice of merger. At stage 3, the insiders decide to submit either a 3-firm merger or a 2-firm one, depending on the respective expected payoffs. The following lemma presents the merger notification trade-off:

**Lemma 1.** *For any $\sigma$, there exist and $\widehat{\Pi}_r(\sigma)$ and $\widetilde{\Pi}_r(\sigma)$ such that:*

then both the CA and the insiders prefer the remedy. But in that case, the discussion on the merger choice is no longer relevant.

*(i) for* $\Pi_r < \widehat{\Pi}_r(\sigma)$*, only 2-firm mergers are notified;*
*(ii) for* $\widehat{\Pi}_r(\sigma) \leq \Pi_r < \widetilde{\Pi}_r(\sigma)$*, only efficient insiders notify a 3-firm merger;*
*(iii) for* $\widetilde{\Pi}_r(\sigma) \leq \Pi_r$*, only 3-firm mergers are notified.*
*Moreover,* $\widehat{\Pi}_r(\sigma)$ *decreases with* $\sigma$ *and* $\widetilde{\Pi}_r(\sigma)$ *increases with* $\sigma$*.*

See proof in the Appendix.

Explicitly, the choice of merger notification gives rise to the following trade-off. On the one hand, a 2-firm merger leads to a risk free profit, given that this merger is always approved. On the other hand, a 3-firm merger is more profitable, but it involves a risk: if it is rejected by the CA, the firm only earns the reservation profit $\Pi_r$. Actually, the lower the reservation profit, the higher the risk incurred (or, equivalently, the higher the opportunity cost). Thus whenever the reservation profit is high, the inefficient as well as the efficient insiders submit the 3-firm merger, and the notification outcome is pooling. Instead, with a lower reservation profit, the inefficient insiders prefer to submit a 2-firm merger, and hence the separation of merger submissions. Finally, the reservation profit can be so low, that even the efficient insiders shun the risky 3-firm merger, and in that case, only 2-firm notifications occur.

Naturally, the risk incurred also depends on the signal quality. The inefficient insiders are more reluctant to run the risk of a 3-firm merger the more accurate the signal, therefore the relevant threshold $\widetilde{\Pi}_r$ increases with $\sigma$. By the same token, a better signal reduces the risk incurred by the efficient insiders when notifying a 3-firm merger. As a result, the threshold $\widehat{\Pi}_r(\sigma)$ below which efficient insiders submit a 2-firm merger decreases with $\sigma$.

In short, there are basically two sources of separation of types following the merger notification: either the reservation profit is not too high, or the quality of information is good.

Turning now to the previous, effort provision stage, let $G(\sigma; \Pi_r)$ denote the gross expected benefit from exerting effort. This function writes:

$$G(\sigma;\Pi_r) = \begin{cases} 0, \text{ if } \Pi_r < \widehat{\Pi}_r \\ \sigma \cdot \Pi(3^e;1) + (1-\sigma)\cdot\Pi_r - (\Pi(2;1;1) + \Pi(1;2;1)), \text{ if } \widehat{\Pi}_r(\sigma) < \Pi_r < \widetilde{\Pi}_r(\sigma) \\ \sigma \cdot \Pi(3^e;1) - (1-\sigma)\cdot\Pi(3;1) + (1-2\sigma)\cdot\Pi_r, \text{ if } \Pi_r > \widetilde{\Pi}_r \end{cases}$$

Basically, the $G$ function summarizes the incentive to exert effort, and firms make the choice to achieve or not the EG based on the comparison between $G$ and the sunk cost $F$. The intuition is straightforward. First of all, whenever

only 2-firm mergers are submitted, it goes without saying that the ED leads to no effort provision. In turn, with separating notifications, firms have incentives to exert effort iff the expected profit exceeds that of a 2-firm merger. Similarly, in case of pooling merger notifications, the incentive to undertake effort is given by the expected profit differential between the efficient and inefficient 3-firm mergers.

Taking into account the two possible levels of the reservation profit following a blocking decision of the CA, we can conclude on the effort provision as shows the following proposition:

**Proposition 1.** *There exists* $\sigma^* \in \left[\frac{1}{2}, 1\right]$ *such that for* $\sigma < \sigma^*$, $G(\sigma; \underline{\Pi}_r) < G(\sigma; \overline{\Pi}_r)$ *whereas for* $\sigma \geq \sigma^*$, $G(\sigma; \underline{\Pi}_r) \geq G(\sigma; \overline{\Pi}_r)$.

See proof in the Appendix.

In other words, for low quality signals, if effort is exerted under the strict ED (without remedy), then this is also the case for the flexible ED (with remedy), whereas for high quality signals, if effort is exerted with divestiture, then effort is also ensured without it. Thus, for $\sigma < \sigma^*$, the flexible ED is likely to be the only means to give effort incentives, whereas for $\sigma > \sigma^*$, the strict ED is more likely to ensure effort provision.

Basically, this proposition deals with the type of merger control that provides the highest effort incentives, depending on the quality of information available. Moreover, it conforms with the standard result in Moral Hazard frameworks, where the agent is guaranteed a higher payoff when information is poor, whereas with better information the principal achieves incentive provision more easily, and the agent is left with a lower reservation payoff. In this respect, note that the effort incentive function $G$ increases with the signal quality, so basically, for low quality signals, to exert effort insiders need a higher payoff, whereas for better quality signals, a lower payoff will still provide effort incentives.

The intuition goes as follows. If the signal is of poor quality, the status-quo profit $\underline{\Pi}_r$ makes very likely the pooling on 2-firm mergers on the one hand, whereas the high reservation profit $\overline{\Pi}_r$ makes likely the pooling on 3-firm ones. Between the two, the highest (actually, non zero) effort incentives occur in the latter case. Besides, even if a not too low $\underline{\Pi}_r$, guarantees the separation of merger notifications, the expected cost for the efficient insiders is high, because of the low signal accuracy. The remedy lowers this cost, so it enhances the effort incentive[18]. If the

[18] This can formally be seen in the expression of the effort incentive function $G$, since the latter is increasing with the reservation profit on the separating interval

signal quality is good, $\underline{\Pi}_r$ ensures the separation of merger submissions, whereas $\overline{\Pi}_r$ can still involve pooling notifications. However, the highest expected profit differential between making effort and not making effort occurs on the separation range[19].

It follows that with a quite good signal, i.e. for a low error probability, the CA will be able to safely increase the cost of a merger refusal by imposing a low reservation profit $\Pi_r = \underline{\Pi}_r$, while still giving incentives to undertake the costly effort. It may seem trivial, and then again it may not. Note that here the signal quality and the merger prohibition cost born by insiders are complementary, whereas the optimal punishment theory[20] typically concludes on the substitutability between the amount of the fine and the punishment probability. Increasing the latter is costly for the principal, and since the agent only responds to the expected fine, it is preferable to increase the amount of penalty to its upper bound. Here, we identify a situation where they are complements, although we do acknowledge the exogeneity of the detection probability. When the latter is rather low, the only way for the CA to ensure effort provision is to allow firms to enjoy a higher reservation profit. In turn, when the signal quality improves, the threat of a return to the status-quo is less and less likely to deter firms from attempting the costly effort, so the CA might safely use this threat and thus cancel all risk of a price raise.

## 4. Optimal merger control: Efficiency Defence or No Efficiency Defence?

So far we have dealt with the optimal design of the ED. However, we equally intend to address the CA's choice between the ED and the NoED decision rules. For that we need first establish the following result:

**Lemma 2.** *For a given effort decision the divestiture is Pareto-dominant; thus, requiring remedy is a weakly dominant strategy for the CA.*

The proof is actually straightforward. Whatever the firms' decision w.r.t. the costly effort, the CA is better off by requiring remedy when turning down a merger, since this would lower the price more. In turn, from the insiders' point of view, the

[19] Note that the effort incentive function $G$ is decreasing with the reservation profit over the 3-firm pooling interval.

[20] See Becker (1968) for instance.

divestiture represents a higher reservation profit than the status-quo. Moreover, requiring divestiture and thereby granting insiders a higher reservation payoff is actually not costly for the CA, since unlike a typical Principal-Agent model, the "rent transfer" does not take place here between the CA and the merging firms, but between the outsider and the merging firms.

To explicit the above result, we detail the reasoning in the case of the strict merger control without an ED. Under this NoED decision rule, 3-firm mergers are always rejected, whatever the exogenous signal about the EG, therefore firms never undertake the costly effort. However, they may yet choose the type of merger to notify. If the CA does not allow remedies, it is trivial to conclude that this decision rule leads only to 2-firm merger notifications. In turn, if the CA challenges all 3-firm mergers by requiring the mandatory divestiture, then the insiders choose to notify such a merger iff the ensuing reservation profit exceeds that of a 2-firm merger. By requiring divestiture the CA obtains at worst $P(2,1,1)$, and at best $P(2,2)$, therefore the remedy is weakly dominant.

Having thus established the optimality of divestiture for a given effort level, we go on now to address the choice of type of merger control to apply, namely the optimal mix of remedy and ED. Given the CA's objective of maximizing Consumers' Surplus, the issue is settled by the expected post-merger price. Assume henceforth that $\overline{\Pi}_r \geq \Pi(2;1;1) + \Pi(1;2;1)$, which is a sufficient condition ensuring both a non-ambiguous price comparison and that $F \in \left[G(\frac{1}{2};\overline{\Pi}_r), G(1;\underline{\Pi}_r)\right]$. The following proposition gives the CA's optimal merger control policy:

**Proposition 2.** ***(I)*** *If $F$ is low, i.e. $F \leq G(\sigma^*;\cdot)$, there exists $\sigma_1(F)$, $\sigma_1 \in \left[\frac{1}{2}, \sigma^*\right]$ such that: (i) for $\frac{1}{2} \leq \sigma < \sigma_1$, the optimal merger control consists in remedy without ED; (ii) for $\sigma_1 \leq \sigma$, the optimal policy consists in the flexible ED.*

***(II)*** *If $F$ is high, i.e. $F \geq G(\sigma^*;\cdot)$, there exist $\sigma_2(F)$ and $\sigma_3(F) \in [\sigma^*, 1]$ such that: (i) for $\sigma < \sigma_2$, the optimal policy consists in remedy without ED; (ii) for $\sigma_2 \leq \sigma < \sigma_3$, the optimal merger control is either remedy without ED, or the strict ED; (iii) for $\sigma_3 \leq \sigma \leq 1$, the optimal policy consists in the flexible ED.*

To prove this, it is enough to sketch graphically the four relevant points $G(\frac{1}{2};\underline{\Pi}_r)$, $G(\frac{1}{2};\overline{\Pi}_r)$, $G(1;\underline{\Pi}_r)$ and $G(1;\overline{\Pi}_r)$ and also different levels of $F$ in the $(\sigma;G)$ space. In the Appendix we compute the expressions of the corresponding expected prices.

The intuition runs as follows. When the effort cost is low, the policy threshold is unique: as soon as the effort incentives provided by the ED exceed the cost of effort, the CA is better off allowing the ED, otherwise, the NoED applies.

Equally important, the CA always require remedy in this case[21]. Indeed, as shown by Proposition 1, when applying the ED for poor quality signals, the highest incentives are provided by adding remedy. To put it short, with low quality signals, there is basically no trade-off facing the CA, since the remedy does provide the highest effort incentive, so the first best is indeed achieved when the effort cost is low.

In turn, when $F$ is high, the relevant signals are of good quality, and in this case, the remedy no longer yields the highest effort provision incentive, as seen in Proposition 1. The optimal merger policy involves now two distinct thresholds. The first one is given by the same trade-off as before, since as long as the ED does not ensure effort, the NoED with remedy is preferred. The second threshold comes from a different trade-off, to the extent that above it the flexible ED (with remedy) provides sufficient incentives for effort to actually occur. Remember though that for $\sigma \geq \sigma^*$, the highest effort incentives are provided by the strict ED. Yet we have seen that applying remedy is preferred by both the insiders and the CA, because for the latter, not requiring a divestiture bears a cost, namely not lowering the price as much as possible. Thus, with a high effort cost and below $\sigma_3$, the CA faces a conflict between either giving incentives through the strict ED, or lowering more the price through the remedy without ED. The comparison is eventually settled by the actual price levels. Above $\sigma_3$, however, the flexible ED is enough to ensure effort, despite the fact that the highest incentives are still given by the strict ED. The previous conflict no longer exists, since the most preferred merger control, i.e. with remedy, does ensure effort.

This proposition deals with the impact of remedy on the design of the optimal merger control. Divestiture and ED appear to be mostly complementary, except for a high effort cost range, where they are substitutes, due to the conflict between incentive provision and the cost of not applying remedy. Basically, for a low effort cost, remedy always applies, either with or without the ED procedure. Without the latter, the divestiture allows the implementation of a lower price through its corrective role, whereas combined with the ED, it ensures the effort incentive, precisely because of the poor signals that are relevant for low $F$. With higher effort cost though, the remedy may not be optimal, namely in the case where only the strict ED ensures effort. However, with very good signals, the flexible ED can become again optimal, but not through the effort-incentive effect, but because it lowers more the price in case of a detection error on behalf of the CA.

[21] Note with this repect that for the low effort costs, the poor quality signals are relevant, simply because the incentive function $G$ is increasing with the signal quality.

To sum up, the divestiture appears complementarity to the ED either through its effort incentive provision or its capacity to minimize the error cost for the CA. Moreover, the remedy can only conflict with the ED when it no longer gives the highest effort incentives. From a Moral Hazard point of view, over the $[\sigma_2, \sigma_3]$ range the First Best cannot be achieved, because the CA faces a trade-off between giving incentives and incurring the corresponding cost[22].

## 5. Conclusion

This paper deals with both the opportunity and the design of the ED procedure. The former purpose is tackled from a different perspective, to the extent that the European ED was long delayed by the costly implementation issues, whereas here we argue that its upstream incentive to encourage more efficient mergers should equally be accounted for, despite the asymmetric information problem. In addition to the opportunity to allow or not the ED, we also addressed the issue of adding divestiture to the trade-off. We analyzed the impact of remedy on the outcome of the ED, and concluded on the design of merger control in terms of optimal mix of divestiture and ED.

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[22] Our model and results are consistent with a Moral Hazard framework, in as much as players are risk-neutral yet the transfers are constrained (the reservation profit equals either $\underline{\Pi}_r$ or $\overline{\Pi}_r$). However, the "rent transfer" (allowing $\overline{\Pi}_r$) is not costly to the principal, therefore the First Best is obtained whenever the remedy ensures the highest effort incentives. The only inefficiency and hence trade-off for the CA occurs when the remedy no longer provides the highest effort incentives.

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## Appendix

**Explicit example.** Consider the linear demand $P = a - Q$, where $P$ is the market price and $Q$ is the total output, and the following constant marginal cost function: $c(K) = x \cdot \frac{1}{K}$, where $K$ is the capital owned by the firm, and $x$ is a parameter measuring the use of this capacity. This formal expression is inspired by Vasconcelos (2005). Marginal cost is decreasing with individual capacity, but the latter can be used more or less efficiently.

The assumptions made in our model are consistent with this cost function for the following specification: let the individual cost of a stand-alone firm before merger be $c(1) = \frac{1}{k}$, where $k$ is the individual indivisible capacity. After a 2-firm merger, the mergerd firm's marginal cost is $c(2) = \gamma\frac{1}{2k}$, whereas the cost of a outsider is unchanged, equal to $c(1)$. After a 3-firm merger, the cost of the merged entity is 0 if effort is made, and equal to $c(3) = \delta\frac{1}{3k}$ without effort.

The assumptions on prices write now as follows:

$P(3,1) > P_i \Leftrightarrow \delta > \frac{21-6ak}{5}$, $P_i > P(2,1,1) \Leftrightarrow \gamma < \frac{12-2ak}{5}$, $P(2,1,1) > P(3^e,1) \Leftrightarrow \gamma > \frac{2ak-4}{3}$, $P(2,2) < P(2,1,1) \Leftrightarrow P_i > P(2,1,1)$, $P(2,2) > P(3^e,1) \Leftrightarrow \gamma > 1$. Checking for positive quantities before merger $\Leftrightarrow ak > 1$, so in all the restrictions needed on parameters are simply $\delta > \frac{21-6ak}{5}$, $\gamma \in \left(1; \frac{12-2ak}{5}\right)$, $ak \in (1; 3.5)$.

To make sure that the rest of hypotheses define a non void set, we check profitability for some specific values of $ak, \gamma$ and $\delta$. More precisely, for $ak = 2, \gamma = 1.5$ and $\delta = 2$, we have that $\Pi(3;1) > \overline{\Pi}_r$, $\overline{\Pi}_r > \Pi(2;1;1) + \Pi(1;2;1)$ and $\Pi(2;1;1) + \Pi(1;2;1) > 3\Pi_i$. Hence, our framework is consistent in the neighbourhood of these values. ■

**Proof of Lemma 1.** Efficient insiders notify a 3-firm merger iff $\sigma \cdot \Pi(3^e;1) + (1-\sigma) \cdot \Pi_r \geq \Pi(2;1;1) + \Pi(1;2;1)$. Define $\widehat{\Pi}_r(\sigma)$ as the reservation profit level

that satisfies with equality the above condition. Therefore, efficient insiders always submit a 3-firm merger provided that $\Pi_r \geq \widehat{\Pi}_r(\sigma)$.

Similarly, inefficient insiders notify a 3-firm merger iff $(1-\sigma)\cdot\Pi(3;1)+\sigma\cdot\Pi_r \geq \Pi(2;1;1)+\Pi(1;2;1)$. Denote now the relevant threshold as $\widetilde{\Pi}_r(\sigma)$, hence for $\Pi_r \geq \widetilde{\Pi}_r(\sigma)$, only 3-firm mergers get notified, since straightforward computation shows that $\widetilde{\Pi}_r(\sigma) > \widehat{\Pi}_r(\sigma)$, due to $\Pi(3^e;1) > \Pi(3;1)$. ■

**Proof of Proposition 1. Compare $G(\frac{1}{2};\underline{\Pi}_r)$ and $G(\frac{1}{2};\overline{\Pi}_r)$** - For $\sigma = \frac{1}{2}$, the incentive constraints for the merger choice of the efficient and inefficient insiders write respectively $\frac{1}{2}\Pi(3^e;1)+\frac{1}{2}\underline{\Pi}_r \lesseqgtr \Pi(2;1;1)+\Pi(1;2;1)$ and $\frac{1}{2}\Pi(3;1)+\frac{1}{2}\underline{\Pi}_r \lesseqgtr \Pi(2;1;1)+\Pi(1;2;1)$. Hence, $G(\frac{1}{2};\underline{\Pi}_r) =$

$$\begin{cases} 0, \text{ if } \underline{\Pi}_r < \widehat{\Pi}_r\left(\frac{1}{2}\right) \text{ [pooling on 2-firm mergers]} \\ \frac{1}{2}\Pi(3^e;1)+\frac{1}{2}\underline{\Pi}_r-(\Pi(2;1;1)+\Pi(1;2;1)), \text{ if } \widehat{\Pi}_r\left(\frac{1}{2}\right) < \underline{\Pi}_r < \widetilde{\Pi}_r\left(\frac{1}{2}\right) \text{ [separation]} \\ \frac{1}{2}\Pi(3^e;1)-\frac{1}{2}\Pi(3;1), \text{ if } \widetilde{\Pi}_r\left(\frac{1}{2}\right) < \underline{\Pi}_r \text{ [pooling on 3-firm mergers]} \end{cases}$$

Since $\overline{\Pi}_r > \underline{\Pi}_r$, $G(\frac{1}{2};\overline{\Pi}_r)$ is obtained by simply replacing $\underline{\Pi}_r$ with $\overline{\Pi}_r$. We have straightforwardly $G(\frac{1}{2};\overline{\Pi}_r)-G(\frac{1}{2};\underline{\Pi}_r) \geq 0$.

**Compare $G(1;\underline{\Pi}_r)$ and $G(1;\overline{\Pi}_r)$** - For $\sigma = 1$, efficient insiders necessarily submit a 3-firm merger whatever the reservation profit, because their incentive constraint becomes $\Pi(3^e;1) > \Pi(2;1;1)+\Pi(1;2;1)$, which holds thanks to merger profitability. In turn, inefficient insiders only submit a 3-firm merger if $\Pi_r \geq \Pi(2;1;1)+\Pi(1;2;1)$. Since $\underline{\Pi}_r < \Pi(2;1;1)+\Pi(1;2;1)$ by the profitability assumption, $G(1;\underline{\Pi}_r)$ coresponds to the gross incentive to exert effort with separating notifications, and thereby $G(1;\underline{\Pi}_r) = \Pi(3^e;1)-(\Pi(2;1;1)+\Pi(1;2;1))$. At the same time, $G(1;\overline{\Pi})$ is equal either to $\Pi(3^e;1)-(\Pi(2;1;1)+\Pi(1;2;1))$, if $\overline{\Pi}_r < \Pi(2;1;1)+\Pi(1;2;1)$, or to $\Pi(3^e;1)-\overline{\Pi}_r$, if $\overline{\Pi}_r \geq \Pi(2;1;1)+\Pi(1;2;1)$. In either case, it is straightforward to check that $G(1;\underline{\Pi}_r) \geq G(1;\overline{\Pi}_r)$.

**Conclusion** - Since $G(\frac{1}{2};\underline{\Pi}_r) \leq G(\frac{1}{2};\overline{\Pi}_r)$ and $G(1;\underline{\Pi}_r) \geq G(1;\overline{\Pi}_r)$, and $G$ is obviously increasing with $\sigma$, there exists a threshold $\sigma^*$ such that $G(\sigma^*;\underline{\Pi}_r) = G(\sigma^*;\overline{\Pi}_r)$, q.e.d. ■

**Expected prices and optimal policy.**

- To show that $F \in \left[G(\frac{1}{2};\overline{\Pi}_r), G(1;\underline{\Pi}_r)\right]$, we check that the constraint on $F$, i.e. $F \geq \Pi(3^e,1)-\Pi(3,1)$ is not contradicted on this interval. Since $G(\frac{1}{2};\overline{\Pi}_r)$ equals $\frac{1}{2}\Pi(3^e;1)-\frac{1}{2}\Pi(3;1)$ for $\overline{\Pi}_r \geq \Pi(2;1;1)+\Pi(1;2;1)$, we have directly that the $\Pi(3^e,1)-\Pi(3,1) \geq G(\frac{1}{2};\overline{\Pi}_r)$. In turn, $G(\frac{1}{2};\overline{\Pi}_r) = \Pi(3^e;1)-(\Pi(2;1;1)+\Pi(1;2;1))$, so $G(\frac{1}{2};\overline{\Pi}_r) \geq \Pi(3^e,1)-\Pi(3,1)$.

- When the strict ED ensures effort, the expected price is $\sigma P\left(3^{e};1\right)+(1-\sigma)\,P_{i}$, whereas if the flexible ED ensures effort, the expected price is lower: $\sigma P\left(3^{e};1\right)+(1-\sigma)\,P(2,2)$. Therefore, if only the strict ED guarantees effort, the CA needs to compare the corresponding price $\sigma P\left(3^{e};1\right)+(1-\sigma)\,P_{i}$ with the one following remedy without ED: $P(2,2)$.

■